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ABSTRACT

A study examined the specific differences in the salary reward systems of eight clusters of academic disciplines included in Biglan's three-dimensional model of the academic profession. The sample consisted of 1,320 faculty at a large research university who responded to the Faculty Activity Analysis questionnaire requesting information on the amount of time they devoted each week to eleven categories of professional responsibility. These measures were used to predict faculty salaries in the eight discipline clusters by stepwise, multiple regression procedures. The results demonstrated wide variation in the reward systems of these discipline clusters. (Author/MSE)

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REWARD STRUCTURES OF ACADEMIC DISCIPLINES

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REWARD STRUCTURES OF ACADEMIC DISCIPLINES

Fiscal constraints facing many colleges and universities have contributed to a heightened interest in the economic status of the academic community and a burgeoning literature on the relationship between faculty activities and faculty salaries. A fundamental issue that persists in the literature is the degree to which institutions of higher learning possess an agreed upon set of criteria for evaluating and rewarding faculty performance. The positions of Katz (1973) and Johnson and Stafford (1974) reflect the basic lack of agreement on this topic; the former contends that the reward structure of academe is founded on ill-defined criteria that are in a constant state of revision, while the latter maintains that institutional judgments concerning faculty performance are based on rather explicit and well known criteria.

Much of the confusion that permeates the literature on the subject results from the search for a single reward structure in a class of organizations that are known for their pluralistic value systems emanating largely from the academic discipline affiliations of their faculty and students. Recent research by Ladd and Lipset (1975), Trow (1975), Wilson and Gaff (1975), and others reveal consistent and wide variations in the patterns of interests, activities, and competencies of faculty in different academic disciplines. These findings suggest strongly the possibility of multiple, or at least highly differentiated, reward structures within institutions of higher learning, based upon the distinctive orientations of various academic disciplines. This possibility is supported by recent evidence that education and economics possess distinctive reward structures which reinforce the unique skills possessed and valued by faculty in each of these disciplines (Tuckman and Hagemann, 1976).

This study seeks to provide further information on the existence of multiple reward structures within the academic community through an investigation of the differential relationships between faculty salaries and faculty activities and professional experience in eight clusters of academic disciplines included in the model of academic disciplines developed by Biglan (1973a). The study differs from previous research in its examination of multiple reward structures and its theoretical orientation. The latter characteristic is especially important given the suggestions of Hobbs and Francis (1973) and Dressel and Mayhew (1974) that research in higher education must devote greater attention to establishing and testing theories and models if the field is to emerge as a respected area of scholarly inquiry.

THE CONCEPTUAL FRAMEWORK

The theoretical model of academic disciplines developed by Biglan (1973a) was derived from the use of nonmetric, multidimensional scaling procedures which were applied to the responses of faculty at a large, public university and a small, denominational liberal arts college concerning the relative similarity of selected academic disciplines. Three dimensions were found to be common to the solutions of both the university and liberal arts college samples.

The label of "hard" versus "soft" was given the first dimension which reflected the degree to which an academic discipline possesses a clearly delineated paradigm. The concept of a paradigm represents the relative consensus within a subject matter area regarding an appropriate set of problems for study and agreed upon methods to be used in their exploration (Kuhn, 1962). The more scientific fields (for example, biological sciences and engineering) tend to possess more clearly delineated paradigms, and these hard disciplines comprise

one end of a continuum for the first dimension; at the other end are such soft disciplines as education and philosophy.

The second dimension reflected the concern of the discipline with the practical application of its subject matter and was labeled "pure" versus "applied". History and mathematics are representative of pure disciplines that traditionally express low concern with practical application, while engineering and accounting were located near the opposite end of this continuum with other disciplines that express a greater concern with the practical application of their subject matter.

The relative involvement with living or organic objects of study was the basis for differentiation of the third dimension entitled "life system" versus "nonlife system". Such disciplines as the biological sciences and education clearly emphasize the study of living systems, whereas astronomy and mathematics do so to a much lesser extent, if at all. The location of each academic discipline on each continuum of Biglan's three-dimensional model model is presented in Table I.

(Insert Table 1 about here)

Additional research by Biglan (1973b) revealed wide variations in the social connectedness (level of involvement with colleagues); preference for and time spent on teaching, research, and service activities; and scholarly productivity of faculty classified according to this model. Smart and Elton (1975; 1976) have also shown broad differences in the goals of academic departments and the administrative roles of department chairmen classified according to this model. Their results tend to be consistent with the earlier findings reported by Biglan (1973b) and the basic tenets of the model defined by Biglan (1973a). This

cumulative evidence suggests that Biglan's three-dimensional model has considerable promise as a conceptual framework to guide systematic research on college and university faculty. The potential of the model to enhance the ability to explain faculty salaries and to understand the multiple reward structures of the academic community constitute the major foci of this study.

RESEARCH PROCEDURES

Data Source. All faculty in a large land-grant university were asked to keep a diary of their professional activities for a one-week period. The following week they were asked to indicate the amount of time they devoted during the preceding week to eleven categories of professional responsibility traditionally performed by university faculty. The Faculty Activity Analysis questionnaire developed by the National Center for Higher Education Management Systems was used to obtain this information.

The eleven categories of professional responsibility were: (1) Instructional Activities, (2) Departmental Research-Scholarly Activities, (3) Departmental Administration-Academic Committee Activities, (4) Academic Program Advising-Informal Tutoring, (5) Course and Curriculum Development, (6) Separately Budgeted-Sponsored Research, (7) Public Service, (8) Academic Support, (9) Student Services, (10) Institutional Support, and (11) Independent Operations-Other. In addition, the years of service at the present institution, total years of professional experience in higher education, and salary of each faculty member were obtained from the personnel record system of the university. Completed questionnaires were received from 1,777 faculty members, a 97 percent response rate. This study was based on the responses of 1,320 faculty whose academic discipline affiliation was included in the eight discipline clusters of Biglan's model (see Table 1).

Data Analysis. Eight separate multiple linear regression equations were computed to examine differences in the reward structures of the eight discipline clusters included in Biglan's model. A ninth equation was computed to assess the overall reward structure of the university. The salaries of faculty in the eight discipline clusters constituted the criterion variable in each of the initial eight regression analyses, and the salaries of all 1,320 respondents constituted the criterion variable in the final university regression analysis. The eleven categories of professional responsibility, years of service at the present institution, and total years of professional experience in higher education were the predictor variables in the regression analyses.

RESULTS

Table 2 presents the means and regression coefficients of the thirteen predictor variables for faculty in each of the eight academic discipline clusters and for the total university sample.

(Insert Table 2 about here)

Enhancement of Prediction Capability. Procedures developed by Rao (1968) were used to assess the ability of Biglan's (1973a) model to improve the ability to explain current faculty salaries; that is, to provide a significant reduction in the amount of error variance. Specifically, the objective was to determine if the regression equations computed for the eight discipline clusters in Biglan's model provided a significant improvement over the predictive ability of the single regression equation for the total university sample.

Following Rao's (1968) procedures, an F-ratio was computed to determine if the pooled residual sum of squares for the eight separate regression equations was significantly lower than the residual sum of squares from the single university equation, given a concomitant loss of residual degrees of freedom when using eight groups. The resulting F-ratio of 4.71 (df=92 and 997; $p < .001$) demonstrated that the use of separate regression equations for the eight discipline clusters in Biglan's model yielded a significantly smaller amount of error variance in explaining faculty salaries than was obtained from the single equation for the total university sample.

Reproduction of the Biglan Model Dimensions. The comparison of eight equations to one supported the use of the eight discipline clusters but did not address the reliability of the three dimensions that underlie the Biglan model. A second analysis of the applicability of Biglan's model to the study of faculty salaries consisted of an attempt to reproduce the three underlying dimensions of the model using euclidian distance measures derived from the thirteen regression coefficients of the eight discipline clusters presented in Table 2.[1] These distance measures formed an eight by eight dissimilarity matrix of euclidian distances which were analyzed using the nonmetric, multidimensional scaling program (MDSCAL) developed by Kruskal (1964) and used by Biglan (1973a).[2] Figure 1 presents the first two dimensions obtained from a three-dimensional MDSCAL solution (stress = .007).

(Insert Figure 1 about here)

Visual interpretation of the plottings of the eight discipline cluster points in Figure 1 revealed that lines could be drawn to split the discipline clusters in a manner reasonably consistent with the three-dimensional

solution reported by Biglan (1973a).[3] The dotted line in Figure 1 tended to differentiate hard from soft disciplines, the dashed line tended to separate pure from applied disciplines, and the line with alternate dots and dashes differentiated life system from nonlife system disciplines. Three of the four points for hard disciplines (HPN being the exception) were below the dotted line and all four soft discipline cluster points were above this line; three of the four points of the pure discipline clusters (SPN being the exception) were below the dashed line and three of the four applied discipline cluster points (SAL being the exception) were above this line; all four points of life system discipline clusters fell below the line with alternate dots and dashes and all four nonlife system discipline cluster points fell above this line. The plotting of points for the eight discipline clusters on the three dimensions provided twenty-four possible classifications, and the fact that three dimensions could be drawn which caused twenty-one of the twenty-four possible locations to be consistent with the postulated classifications of the Biglan model exceeds by far chance possibility.

Inspection of the dotted and dashed lines in Figure 1 revealed that they were perpendicular, which indicates that the first (hard versus soft) and second (pure versus applied) dimensions of the Biglan model are statistically independent. However, the line with alternate dots and dashes was not perpendicular to either of the two other lines which suggests that the third dimension (life system versus nonlife system) is not statistically independent; that is, the third dimension interacts with the first and second dimensions.

Variation in Discipline Cluster Reward Structures. The regression coefficients presented in Table 2 represent the dollar value associated with

each unit (either hours of activity per week or years of experience) measured by the thirteen predictor variables and were therefore used to examine the variability in the reward structures of the eight discipline clusters of Biglan's model. While space limitations precluded the discussion of all twenty-eight possible comparisons between the eight discipline clusters, the following comparisons reflected the wide variability in the reward structures that were present in these eight groups of academic disciplines.

Table 3 presents the twenty-eight Spearman rank order correlation coefficients, rho, between the eight discipline clusters based upon the size (i.e. dollar value) of the regression coefficients for the eleven Faculty Activity Analysis predictor variables (numbers one through eleven) in the equations of the eight groups of academic disciplines (see Table 2).

(Insert Table 3 about here)

Inspection of the rank order correlation coefficient matrix in Table 3 demonstrated the wide variation present in the reward structures of these eight discipline clusters. For example, twenty-two of the twenty-eight measures were between +.30 and -.30, indicating little or no similarity among these disciplinary reward structures. The three categories of professional responsibility with the largest regression coefficients in the HPN equation (Departmental Administration; Curricular Development; Student Services) were fifth-tenth- and seventh, respectively in the SAN equation; the two largest coefficients in the HPL equation (Independent Operations; Student Services) were eleventh and tenth, respectively in the SPL equation; the three largest coefficients in the HAL equation (Institutional Support; Student Services; Academic Advising) were eleventh-seventh- and eight,

respectively in the SAN equation. Such variability in the dollar value associated with these eleven areas of professional responsibility was evident to varying degrees throughout the data and provided strong evidence in support of the distinctive characteristics of the reward structures of these eight academic discipline clusters.

Inspection of the regression coefficients in Table 2 for the two variables related to years of experience indicated that while total years of professional experience in higher education contributed to higher salaries, the reverse was true for years of experience at the present institution. This relationship was the case in the regression equations for all eight discipline clusters. The implication of this result is that those faculty who move to the institution in senior professorial ranks during the mid- or later stages of their careers tend to receive higher salaries than faculty whose total years of professional experience in higher education have predominantly been at the present institution. Again, this finding was true in all eight discipline clusters.

DISCUSSION

The results of this study suggest that efforts to assess a single institutional reward structure are not advisable since the failure to consider the distinctive orientations of subject matter areas is likely to mask different relationships between the predictor variables and the criterion measure in different academic disciplines; conversely, it is equally inadvisable to generalize the findings from an analysis of one or a few disciplines to the reward structures of other subject matter areas. The small size of many disci-

pline or departmental faculties precludes the use of the individual discipline or department as the organizational unit of inquiry since the results derived from analyses based on five to fifteen individuals are not likely to have sufficient reliability; even ignoring this important methodological consideration, it would be intellectually impossible to comprehend the results of analyses based on the 50 to 150 academic disciplines or departments that are normally present in major universities. Thus, neither the entire university faculty nor the individual faculties of disciplines are appropriate organizational units of inquiry. This dilemma faces all researchers involved in the study of the interests, values, activities, and reward structures of the academic community.

One solution to this dilemma is the use of middle range theory to formulate clusters of academic disciplines which, on the one hand, are restrictive enough to capture the salient distinctions of reasonably similar matter areas and yet, on the other hand, are sufficiently comprehensive to encompass most academic disciplines. The three-dimensional model developed by Biglan (1973a) and supported by the findings of Biglan (1973b) and Smart and Elton (1975; 1976) appears to satisfy this prevailing need in the higher education research literature (Hobbs and Francis, 1973; Dressel and Mayhew, 1974).

Specific support for the applicability of Biglan's model to the study of reward structures in universities is provided by the results of this study. From primarily a statistical point of view, the results demonstrate that the use of the eight discipline clusters in the Biglan model significantly improves the ability to explain (i.e., predict) faculty salaries; from a more theoretical perspective, the results indicate that the three dimensions which underlie the Biglan model can be reproduced and presumably are imbedded in the reinforcement

patterns (i.e., reward structures) of a large university. Such evidence provides further support for the methodological and theoretical appropriateness of the Biglan model to the study of members of the academic profession.

The results of this study also have importance to those responsible for the management of colleges and universities and the representation of faculty interests within these institutions. For example, American higher education is currently facing several forces and trends in society that are supportive of increasing standardization of institutional policies and procedures. The collective bargaining movement which has gained considerable momentum in colleges and universities during the past decade is one such trend which, some believe, has the potential to virtually wipe out institutional autonomy and diversity (Kemerer and Baldridge, 1975). A dominant orientation within the movement has been a serious concern for the job security and the economic status of faculty and efforts to establish uniform criteria, policies, and procedures in the evaluating and rewarding of faculty performance. The adoption of uniform standards would in essence lead to a single reward structure for organizations that have traditionally been characterized by their diversity and multiple reward structures, as shown by the results of this study.

The methodology used in this study could be adopted by institutional administrators and faculty representatives to assess the relative impact of a single standardized institutional reward structure on their faculties in different disciplines, departments, and colleges. Table 4 presents the contribution of each of the thirteen predictor variables in this study to the current salary average of faculty in each of the eight discipline clusters based upon (a) the distinctive reward structure of each discipline cluster and (b) the single university reward structure.[4]

(Insert Table 4 about here)

The average salary of faculty in each of the eight discipline clusters under its present unique discipline reward structure and the potential single university reward structure is presented in the last row of Table 4. Inspection of this bottom row indicates that HPN, HAN, SAL, and SAN faculty benefit from the present circumstances in the university which permit wide variation in the reward structures of individual discipline groups; conversely, HPL, HAL, SPL, and SPN faculty would benefit from the introduction of a single university reward structure. These differences are greater for faculty in HPN disciplines who realize a $4,403 benefit from the ability to use their own distinctive discipline reward structure and for faculty in HPL subject matter areas who would hypothetically gain $4,202 from the introduction of a single university reward structure. Such analyses could be employed by faculty representatives to assess the financial consequences of a single standard university reward structure on the average salary of their respective constituencies and by administrators of colleges and universities to examine the likely sources of support and opposition to efforts to introduce a single reward system in their institution. Clearly, however, the initiation of a single institutional reward structure is likely to generate heated debates within the academic community for both philosophical and financial reasons.

In summary, the findings of this study have both theoretical and practical implications. They provide further support for the Biglan model as a conceptual framework to guide systematic research on members of the academic profession. The availability of such a model could help to alleviate one of the major weak-

nesses of this area of scholarly inquiry. The findings can also aid college and university administrators in the understanding of disciplinary diversity within their respective institutions and assessing the sensitivity of different faculty groups to proposed changes in the institution's salary reward structure.

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FOOTNOTES

1. $$D_{ij} = \sqrt{\sum_{k=1}^{13} (B_{ij} - B_{jk})^2}$$

2. Nonmetric, multidimensional scaling is a procedure used to represent N points with reduced dimensions in Euclidian space starting with the information about the rank order of the dissimilarities for the N(N-1/2) pairs. While the analytical procedure is highly complex (see Gnanadeskan, 1977; Osiris III, 1974), it can be viewed in general terms as a procedure analogous to factor analysis but requiring substantially weaker assumptions about the input data.

3. Continuing the analogy to factor analysis in the preceding footnote, the lines shown in Figure 1 can be viewed as factors with their perpendicular reference vectors having loadings which, in one sense, maximize the difference the eight discipline clusters in Biglan's model. It is also interesting to note that lines drawn for the hard-soft and pure-applied Biglan dimensions are related to the dimensions of MDSCAL by a translation of the origin and rotation. Furthermore, the line for the life system-nonlife system dimension, while it could be drawn through the intersection of the two other Biglan dimensions, is not statistically independent (orthogonal) of the hard-soft or pure-applied dimensions.

4. The figures in Table 4 are obtained from use of the regression coefficients and group means reported in Table 2. For example, the $1,285 contribution of Instructional Activities to the current salary average of HPL faculty under the single university reward structure was derived by multiplying the regression coefficient of this predictor variable for the university sample ($88) times the hours devoted to this area of professional responsibility by HPL faculty (14.6); on the other hand, the $774 contribution of Instructional Activities to the current average salary of HPL faculty under its own unique discipline reward structure was obtained by multiplying the regression coefficient of this predictor variable for the HPL sample ($53) times the hours devoted to this area of professional responsibility by HPL faculty (14.6). Summing across the thirteen predictor variables and the constant term yields the current average faculty salary for each discipline cluster based upon a single university reward structure and its own unique discipline reward structure.

Table 1

Biglan's Model of Academic Disciplines

	Hard[a]		Soft[a]	
	Nonlife system[c]	Life system[c]	Nonlife system[c]	Life system[c]
Pure[b]	Astronomy Chemistry Geology Mathematics Physics	Botany Entomology Microbiology Physiology Zoology	English History Philosophy Communications	Anthropology Political Science Psychology Sociology
Applied[b]	Ceramic engineering Civil engineeting Computer science Mechanical engineering	Agronomy Dairy Science Horticulture Agricultural economics	Accounting Finance Economics	Educational administration and supervision Secondary and continuing education Special education Vocational and technical education

[a] "Hard" or scientific departments are characterized by a paradigm or agreed upon set of problems and methods; "soft" departments do not have a clearly delineated paradigm.

[b] "Pure" departments are not particularly concerned with practical application, while "applied" departments are concerned with practical application.

[c] "Life systems" departments place greater emphasis on the study of living systems, while "nonlife systems" departments are characterized by a relative lack of emphasis on organic objects.

Table 2

Results of Regression Analyses: Means and Regression Coefficients

PREDICTOR VARIABLES		Biglan Discipline Clusters HPL N = (104)	HPN (163)	HAL (205)	HAN (221)	SPL (66)	SPN (146)	SAL (106)	SAN (92)	UNIVERSITY SAMPLE (1103)
Instructional Activities	$\bar{X}$	14.6	23.1	9.7	25.6	24.1	29.6	25.0	24.6	21.5
	B	53	178	56	91	14	-15	63	64	88
Scholarly Research	$\bar{X}$	10.5	13.4	9.4	6.0	13.7	12.4	4.8	14.2	10.0
	B	-52	159	45	158	31	69	107	175	100
Departmental Administration	$\bar{X}$	3.6	4.3	3.5	4.7	5.3	4.6	5.1	4.9	4.4
	B	217	349	124	353	137	163	242	124	236
Academic Advising	$\bar{X}$	3.6	4.6	2.6	4.0	5.2	4.8	5.9	5.0	4.2
	B	156	106	128	141	52	102	136	0	127
Curricular Development	$\bar{X}$	2.0	1.3	1.1	1.6	2.2	2.3	3.0	0.9	1.7
	B	-17	303	0	104	16	57	56	-37	47
Sponsored Research	$\bar{X}$	12.9	2.9	7.1	6.7	0.8	0.2	4.7	1.2	4.9
	B	11	246	28	207	75	53	112	233	118
Public Service	$\bar{X}$	4.8	0.2	14.3	2.8	0.2	0.6	2.0	1.2	4.1
	B	13	-455	70	105	222	296	179	308	97
Academic Support	$\bar{X}$	0.9	1.0	1.0	1.0	0.5	0.8	1.2	0.6	0.9
	B	42	197	67	21	0	-41	498	272	103
Student Services	$\bar{X}$	0.7	0.3	0.7	0.8	2.9	0.9	1.5	1.0	0.9
	B	567	288	230	194	-112	0	52	26	31
Institutional Support	$\bar{X}$	0.5	0.1	0.3	0.2	0.0	0.2	0.9	0.2	0.3
	B	-26	-86	239	-124	0	196	58	-244	71
Independent Operations	$\bar{X}$	0.2	0.9	0.0	0.1	0.0	0.1	0.0	0.4	0.1
	B	3577	-450	0	258	-1788	142	-874	-35	67
Years: This Institution	$\bar{X}$	9.4	7.7	10.9	8.4	3.3	6.6	3.9	4.8	7.6
	B	-233	-145	-325	-90	-31	-353	-96	-682	-306
Total Years Experience	$\bar{X}$	13.5	11.5	14.1	11.7	7.3	10.2	7.5	9.2	11.2
	B	393	459	437	244	681	582	162	890	481
R^2		.58	.52	.39	.38	.88	.74	.46	.62	.39

Table 3

Rank Order Correlation of Biglan Clusters

	HPL	HPN	HAL	HAN	SPL	SPN	SAL
HPN	.08						
HAL	.12	-.07					
HAN	.51	.25	-.23				
SPL	-.29	.08	.03	.21			
SPN	-.08	-.49	.25	.18	.38		
SAL	-.13	.09	.23	-.08	.66	.03	
SAN	-.08	.00	-.08	.13	.52	-.17	.72

Table 4

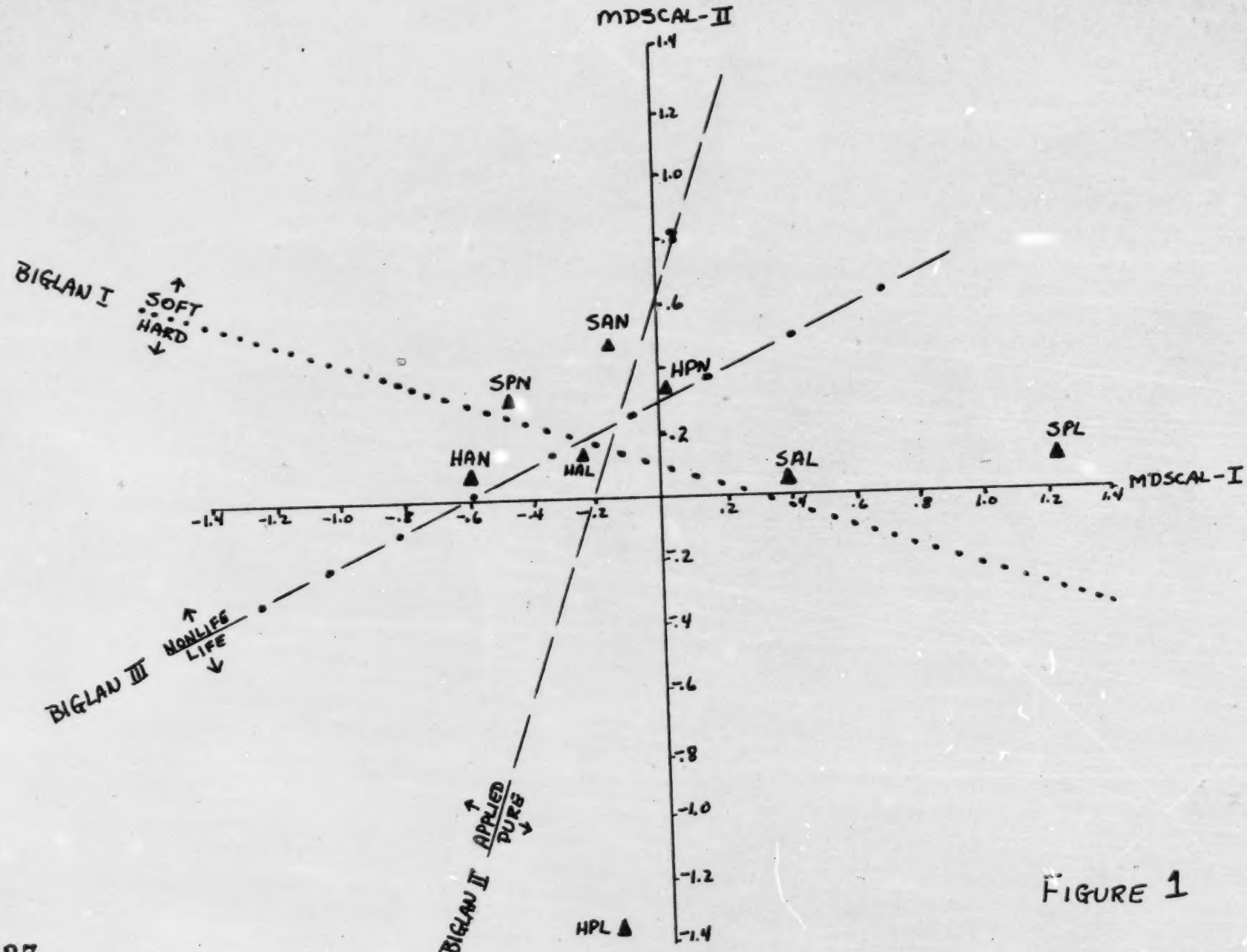
University Versus Discipline Cluster Reward Structures*

PREDICTOR VARIABLES		HPL	HPN	HAL	HAN	SPL	SPN	SAL	SAN
Instructional Activities	U	1285	2033	854	2253	2121	2605	2200	2165
	D	774	4112	543	2330	337	-444	1575	1574
Scholarly Research	U	1050	1340	940	600	1370	1240	480	1420
	D	-546	2331	423	948	425	856	514	2485
Departmental Administration	U	850	1015	826	1109	1251	1086	1204	1156
	D	781	1501	434	1660	726	750	1234	608
Academic Advising	U	457	584	330	508	660	610	749	635
	D	562	488	333	564	270	490	802	0
Curricular Development	U	94	61	52	75	103	108	141	42
	D	-34	394	0	166	35	131	168	-33
Sponsored Research	U	1522	342	838	791	94	24	555	142
	D	142	713	199	1387	60	11	526	280
Public Service	U	466	19	1387	272	19	58	194	116
	D	62	-91	1001	294	44	178	358	370
Academic Support	U	82	103	103	103	52	82	124	62
	D	38	197	67	21	0	-33	598	163
Student Services	U	22	9	22	25	90	28	47	31
	D	397	86	161	155	-325	0	78	26
Institutional Support	U	36	7	21	14	0	14	64	14
	D	-13	-9	72	25	0	39	52	-49
Independent Operations	U	0	7	0	7	0	7	0	27
	D	0	-45	0	26	0	14	0	-14

Table 4 (contd.)

PREDICTOR VARIABLES		HPL	HPN	HAL	HAN	SPL	SPN	SAL	SAN
Years: This Institution	U	-2876	-2356	-3335	-2570	-1010	-2020	-1193	-1469
	D	-2190	-1117	-3543	-756	-102	-2330	-374	-3274
Total Years Experience	U	6494	5532	6782	5628	3511	4906	3608	4425
	D	5306	5279	6162	2855	4971	5936	1215	8188
Constant	D	11557	4296	10328	8909	9998	9009	8896	9187
Average Salary	U	21037	12992	19147	17722	18260	17757	14917	17954
	D	16835	17395	16180	18533	16440	14607	15642	19511

* The row for each variable preceded by a "U" represents the contribution of that variable to the average salary of faculty in each discipline cluster based upon a single University reward structure, while the row preceded by a "D" represents the contribution of that variable to the average salary of faculty in each discipline cluster based upon its own unique discipline reward structure.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MDSCAL-I
BIGLAN I
SOFT
HARD
BIGLAN II
APPLIED
PURE
BIGLAN III
NONLIFE
LIFE
SAN
SPN
HPN
HAN
HAL
SAL
SPL
HPL
1.4
1.2
1.0
.8
.6
.4
.2
-.2
-.4
-.6
-.8
-1.0
-1.2
-1.4

FIGURE 1